

Client's ref. : VIT02-0045
Our ref: 0608-7907us /Karen

What is claimed is:

1 1. An adaptive multi-modulus equalization method for
2 an equalizer, comprising the steps of:
3 storing an input signal;
4 generating initial values for a plurality of equalizer
5 coefficients;
6 calculating a constant modulus algorithm (CMA) cost
7 function output according to a CMA with an
8 equalized signal from the equalizer;
9 estimating a CMA adjustment amount for updating the
10 equalizer coefficients according to the CMA cost
11 function output;
12 determining modulus of each region for a multi-modulus
13 algorithm (MMA) by statistical analysis of the
14 equalized signal;
15 switching the equalizer to use the MMA when the CMA
16 cost function output reaches a first threshold,
17 wherein the MMA comprises a plurality of stages
18 determined by thresholds, and the number of
19 regions increases in each subsequent stage;
20 calculating a MMA cost function output according to the
21 MMA with the equalized signal and modulus of each
22 region;
23 estimating a MMA adjustment amount for updating the
24 equalizer coefficients according to the MMA cost
25 function output;

26 determining modulus of each region for the subsequent
27 stage of the MMA by statistical analysis of the
28 equalized signal;
29 switching the equalizer to the subsequent stage of the
30 MMA when the MMA cost function output reaches the
31 threshold corresponding to the current stage;
32 repeating the steps of calculating the MMA cost
33 function output, determining modulus of each
34 region, and switching the equalizer to the
35 subsequent stage until the MMA cost function
36 output reaching a preset value; and
37 fixing the number of regions and equalizer coefficients
38 to equalize the input signal when the MMA cost
39 function output has reached the preset value.

1 2. The method as claimed in claim 1 further
2 comprising the steps of:
3 phase recovering and non-linear transforming the
4 equalized signal into a recovered signal; and
5 inputting the recovered signal to a decision feedback
6 equalizer.

1 3. The method as claimed in claim 1 wherein the CMA
2 cost function output and the MMA cost function output are
3 calculated by two second-order discrete cost functions.

1 4. The method as claimed in claim 1 wherein the
2 constant modulus algorithm (CMA) is implemented by a
3 steepest gradient descent algorithm.

1 5. The method as claimed in claim 1 wherein the
2 multi-modulus algorithm (MMA) is implemented by a steepest
3 gradient descent algorithm.

1 6. An adaptive multi-modulus equalizing system,
2 comprising:
3 an equalizer, generating an equalized signal from an
4 input signal according to equalizer coefficients;
5 a first coefficient generator, estimating a first
6 adjustment amount by calculating a first cost
7 function output according to a constant modulus
8 algorithm (CMA);
9 a second coefficient generator, estimating a second
10 adjustment amount by calculating a second cost
11 function output according to a multi-modulus
12 algorithm (MMA); and
13 a multiplexer connected to the equalizer, selecting
14 either the first adjustment amount or the second
15 adjustment amount with which to update the
16 equalizer coefficients depending on a first
17 threshold;

1 7. The system as claimed in claim 6, wherein the
2 first coefficient generator calculates the first cost
3 function output from the input signal and the equalized
4 signal.

1 8. The system as claimed in claim 6, wherein the
2 second coefficient generator calculates the second cost
3 function output from the input signal, the equalized signal,

4 and moduli obtained by statistical analysis of the equalized
5 signal.

1 9. The system as claimed in claim 8, wherein the
2 number of moduli used to calculate the second cost function
3 output is incremental when the second cost function output
4 reached a second threshold.

1 10. An adaptive multi-modulus equalization method for
2 an equalizer, comprising the steps of:
3 storing an input signal;
4 generating initial values for a plurality of equalizer
5 coefficients;
6 calculating a constant modulus algorithm (CMA) cost
7 function output according to a CMA with an
8 equalized signal from the equalizer;
9 estimating a CMA adjustment amount for updating the
10 equalizer coefficients according to the CMA cost
11 function output; and
12 determining modulus of each region for a multi-modulus
13 algorithm (MMA) by statistical analysis of the
14 equalized signal.

1 11. The method as claimed in claim 10 further
2 comprising the step of switching the equalizer to use the
3 MMA when the CMA cost function output reaches a first
4 threshold, wherein the MMA comprises a plurality of stages
5 determined by thresholds, and the number of regions
6 increases in each subsequent stage.

1 12. The method as claimed in claim 11 further
2 comprising the steps of:
3 calculating a MMA cost function output according to the
4 MMA with the equalized signal and modulus of each
5 region;
6 estimating a MMA adjustment amount for updating the
7 equalizer coefficients according to the MMA cost
8 function output; and
9 determining modulus of each region for the subsequent
10 stage of the MMA by statistical analysis of the
11 equalized signal.

1 13. The method as claimed in claim 12 further
2 comprising the step of switching the equalizer to the
3 subsequent stage of the MMA when the MMA cost function
4 output reaches the threshold corresponding to the current
5 stage.

1 14. The method as claimed in claim 13 further
2 comprising the steps of:
3 repeating the steps of calculating the MMA cost
4 function output, determining modulus of each
5 region, and switching the equalizer to the
6 subsequent stage until the MMA cost function
7 output reaches a preset value; and
8 fixing the number of regions and the equalizer
9 coefficients to equalize the input signal when
10 the MMA cost function output has reached the
11 preset value.

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1 15. The method as claimed in claim 14 further
2 comprising the steps of:
3 phase recovering and non-linear transforming the
4 equalized signal into a recovered signal; and
5 inputting the recovered signal to a decision feedback
6 equalizer.

1 16. The method as claimed in claim 15 wherein the CMA
2 cost function output and the MMA cost function output are
3 two second-order discrete cost functions.

1 17. The method as claimed in claim 10 wherein the CMA
2 is implemented by a steepest gradient descent algorithm.

1 18. The method as claimed in claim 10 wherein the MMA
2 is implemented by a steepest decent algorithm.